INTRODUCTION

This chapter reflects the efforts of the Hydrologic Modification working group to reduce the impacts associated with hydrologic modification to Tennessee's streams, rivers, and lakes. Hydrologic modification, or hydromodification, includes stream projects such as dredging, channelization, stream alterations, flow modification and regulation, shoreline erosion, wetland disturbances, dam construction and others. In Tennessee, hydromodification impacts streams and lakes by impairing their designated uses: 54 miles of streams are partially supporting and 38.6 are not supporting. Impacts on Tennessee's lakes: 745 acres partial supporting their designated use, TDEC-WPC 1998 303(d) Report. Management measures under this category must attempt to control the addition of pollutants to surface and ground waters by implementing the best available nps control practices, technologies, processes, criteria, operating methods and other alternatives. The working group was created to advise and set goals for the NPS Program on all hydromodification related issues related to nps.

DESCRIPTION

The nonpoint sources of pollution covered under Hydrologic Modification are grouped into three categories:

1) Stream Modification, 2) Construction, and 3) Flow Modification and Regulation.

1. Stream modification activities include
   - stream obstruction removal
   - stream channel relocation
   - channelization
   - lateral drainage and maintenance
   - sand and gravel dredging
   - maintenance dredging
   - bank stabilization.
2. Construction activities include
   - roads, bridges, and culverts
   - low-head impoundment structures and dams
   - electric transmission line construction and maintenance.
   - housing and commercial development.
1. Flow modification and regulation activities include reservoir releases and tailwaters (below the dam)

The Division of Water Pollution Control is responsible for the administration of the Tennessee Water Quality Control Act of 1977 (T.C.A. 69-3-101). Under the Water Quality Control Act, municipal, industrial and other discharges of wastewater must obtain a permit from the Division. Approximately, 1,700 permits have been issued under the federally delegated National Pollutant Discharge Elimination System (NPDES). These permits establish pollution control and monitoring requirements based on protection of designated uses through implementation of water quality standards and other applicable state and federal rules. Additional information about the permits issued by the Division of Water Pollution Control is found in the Environmental Permitting Handbook: http://www.state.tn.us/environment/permits/handbook/. Activities such as stream channel modifications, wetland alterations or gravel dredging are regulated by this Division. An average of 850 Aquatic Resource Alteration permits, including 125 gravel dredging authorizations are issued annually.

EXTENT OF PROBLEM

Hydrologic modification activities are responsible for several hundred miles of streams and several thousands of acres of lakes being impaired for various reasons. The following tables, taken from "The Status of Water Quality in Tennessee" 1998 305(b) Report, summarizes the impact of various sources:

Hydro/Hydrologic Modification Sources of pollutants in Rivers

Source Category	Total Impact (miles)
Channelization	6,052
Dredging	191
Flow Regulation	8
Filling and Draining Wetlands	332
Streambank Modification	250
Streambank Destabilization	24
Riparian loss	639
Habitat Modification	202
Hydromodification	378

Hydro/Habitat Modification Sources of pollutants in Lakes

Source Category	Total Impact (acres)
Channelization	4,550
Flow Regulation	15,500
Filling and Draining Wetlands	10,950
Dam Construction	0
Hydromodification	745

The use most often impacted by hydrologic modification activities, is fish and aquatic life, resulting from erosion and siltation, habitat alterations or destruction, thermal and dissolved oxygen modifications, and flow alteration. To a lesser extent, impacts to water

supply and recreation uses due to hydrologic modification activities, have also been documented.

For the purposes of this document, this chapter will focus on the following hydrologic modification activities: stream obstruction removal, stream channel relocation, channelization, lateral drainage and maintenance, sand and gravel dredging, maintenance dredging, bank stabilization; road, bridge, and culvert construction, low-head impoundment structures and dams; electric transmission line construction and maintenance; development, and reservoir releases and tailwaters - increasing dissolved oxygen (D.O.).

Wetlands:
It is estimated that Tennessee has lost 59% of its wetlands by the mid 1980's. In the past, losses of wetlands were primarily due to agricultural conversion, drainage, channelization, and sedimentation. At present, the loss/gain balance is complicated and not well defined. Current professional opinion and supporting data from the 1992 National Resources Inventory contend that the rate of wetland losses in Tennessee has significantly declined and that wetland acreage may be increasing. However, comprehensive data does not exist to accurately measure this decline. Factors affecting the balance include both primary land use conversions and long term changes in the hydrology of major drainage basins.

Although each drainage system is unique, Tennessee's wetland managers have identified several general trends, based on their observations, knowledge, and experience:

- Agricultural conversions are decreasing;
- Marginal cropland is being abandoned and allowed to revert to wetlands;
- There is less conversion of bottomland hardwoods (BLH) to cropland;
- Urban conversions are increasing; and
- Transportation impacts (highways, airport construction) are a growing factor in wetland loss, however the use of mitigation in these projects is helping to limit the net loss of wetlands acreage.
- In 1988, the former Tennessee Department of Conservation formulated a "State Wetlands Plan" as an addendum to the State Recreation Planning Report, in compliance with the Federal Emergency Wetlands Resource Act. Aerial photography and satellite imagery were used to determine that the state's vegetated wetlands comprised 639,177 acres (571,000 ac. or 89% in the western grand division and 68,177 ac. or 11% in the remainder of the state).

Massive direct and indirect human impacts have led to a significant reduction in the quality of Tennessee's wetlands. Many areas have remained in a state of early ecological succession and have not been allowed to develop naturally toward ecological maturity. Excessive or inadequate water inputs, high sediment or nutrient loads, and direct or indirect interference with vegetation have caused imbalance among the physical, chemical, and biological processes that determine wetland functions. The natural processes that might restore functional equilibrium are rarely allowed to proceed without additional interference.

Although the general picture of disequilibrium in Tennessee's wetlands is fairly clear, we do not have the detailed information necessary to fully understand and protect our wetlands resource. No state or federal agency is systematically collecting, recording, or analyzing complete information on wetlands. Except in relatively few cases where wetlands are perceived as threatened or are under consideration for purchase, little information is currently being collected on wetland functions. Such information as it is available is generally site-specific, and is collected under protocols narrowly designed to meet regulatory or agency requirements. There continues to be a major need for a consistent statewide program to evaluate the quality and functions of wetlands and monitor their condition.

Stream hydrology alteration has increased in many areas of Tennessee mainly because of landuse changes. The primary one is the conversion of farmland to housing and commercial developments; urban sprawl is a major contributing factor of this. More and better roads have allowed population to live further and further from major cities and the necessary commercial infrastructure has followed. Consequently, increasing imperviousness of the watershed has altered surface and subsurface flow. Along with the stream hydrology changes, comes streambank erosion; siltation increase; habitat destruction, introduction of other pollutants, decrease of DO and alteration of the entire stream ecology. The need for more ecologically sound development is imperative. More and better ordinances are necessary along with education of the public, county, city and developers.

Tennessee's 1998, 303(d) List has identified 352 waterbodies that do not fully support all of their designated uses. Of this number, 126, or 36% of the total number of waterbodies are impaired by hydrologic modification activities. The 1998 303(d) List has identified these activities by the use of the following terms:

Agriculture
Animal Feeding Areas
Animal Holding Areas
Concentrated Animal Feeding Operations
Crop Production
Non-Irrigated Crop Production
Pasture/Grazing
Pastureland
Specialty Crop Production

SOLUTIONS

Hydromodification should be avoided when feasible. Where hydromodifications are unavoidable, BMPs should be implemented to avoid or minimize water quality impacts. BMPs exist for all three categories of Hydrologic Modification activities, (i.e., stream modification, construction, and flow modification and regulation). The BMPs developed for the first two activity categories (stream modifications and construction) are usually adequate to protect classified stream uses in Tennessee. Some BMPs for the third activity category (reservoir releases and tailwaters) are available, but with varying success. Site specific characteristics at each dam are still the most difficult factor to overcome in implementing cost-effective BMPs.

The need for integrated watershed management of all point and nonpoint sources, in conjunction with implementation of specific BMPs, cannot be over emphasized. In analyzing the BMPs for hydrologic modification activities, the need for managing nonpoint sources on an entire watershed basis was identified. Excessive soil erosion is a significant cause and effect of river basin-wide problems, and runoff from agricultural, urban, and mining land uses introduce pollutants that are major contributors to oxygen depletion in reservoirs.

The NPS program funds TDEC-WPC for assessment of the water quality across the state. The 303(d) designates the extent hydromodification is effecting the designated uses of the resource. As stated in the introduction: according to the 1998 303(d) Report hydromodification impacts streams and lakes by impairing their designated uses: 54 miles of streams are partially supporting and 38.6 are not supporting. Impacts on Tennessee's lakes: 745 acres partial supporting their designated use. The NPS program has instituted the Grant Pool program that is focused towards taking these streams off the list. With each iterative of the report, we will adjust projects and focused streams.

TVA's Watershed Teams actively works to implement cooperative water quality improvement projects throughout the Tennessee Valley. Watershed Teams provide technical assistance to communities involved in wetland protection efforts, and incorporate wetland protection into riparian zone protection and streambank restoration projects. These teams also implement a key goal of the Strategy by providing on-going outreach and education projects to local schools, community, and civic groups that include information about the value of wetlands for watershed health.

MANAGEMENT MEASURES

BMPs for Stream Obstruction Removal - Major Blockage
(Major blockage: causing unacceptable flow problems. Obstructions consist of compacted debris, and/or sediment that severely restrict flow).

1. Access Route Management
2. Equipment Selection
3. Material Disposal
4. Bank Clearing (minimum)
5. Channel Maintenance-Restoration
6. Bendways (old river runs)

BMPs for Stream Obstruction Removal – Non-major Blockage
(Non-major blockage: log jams and sediment deposits that occupy 25 percent or more of the channel or are located mid-channel such that increased blockage is likely to occur. This practice would involve only minor sediment removal.)

1 Access Route Management
2. Bank Clearing (minimum)
3. Material Disposal
4. Woody Vegetation Removal Guidelines

BMPs for Stream Obstruction Removal - Minor Accumulation of drift and Debris
(Minor accumulation of drift and debris: no major flow impediment, but existing conditions would likely result in obstructions in the near future if not addressed immediately, causing unacceptable problems.)

1. Equipment Selection
2. Material Disposal
3. Woody Vegetation Removal Guidelines

BMPs for Stream Channel Relocation

1. Pool and Riffle Creation
2. Channel Dimensions
3. Erosion Control
4. Revegetation for Stabilization
5. Work Completion and Stabilization before Water Diversion
6. Bank Stabilization
7. Sediment Basins

BMPs for Channelization - Deteriorated Channel
(Channel deteriorated to point where normal streamflow is forced into floodplain.)

1. One Bank Channelization of Main Streams
2. Access Route Management
3. Material Disposal
4. Bank Clearing (minimum)
5. Bendways
6. Drop Structures
7. Watershed Management

BMPs for Channelization - Channel Enlargement
(Enlargement or enhancement of natural flood carrying capacity of stream through excavation, i.e. used to carry 100 year flood through developed areas.)

1. Leave Stream In Natural Condition
2. Creation of a Mitigated Channel
3. Dry Operations
4. Stabilization of Disturbed Areas when Relocation is Necessary

BMPs for Lateral Drainage and Maintenance

1. Flood Plain Management
2. Material Disposal
3. Equipment Selection
4. Access Route Management
5 Alignment (of lateral drains)

BMPs for Sand and Gravel Dredging
(Applies to small streams not covered under Federal Regulatory Program.)

1. Dry Excavation
2. Access Route Management
3. Stream Crossing Limitations
4. Material Disposal

BMPs for Maintenance Dredging

1. Planning and Scheduling of Work
2. Excavation
3. Access Control
4. Dredged Material Uses and Placement

BMPs for Soil Erosion Control for Road, Bridge, and Culvert Construction

1. Staked Hay Bales and Silt Fences
2. Buffer Strips
10. Waterspreading
11. Waterways

3. Sediment Structures
4. Check Dams
5. Brush barriers
6. Clearing and Grubbing Constraint
7. Temporary Berms
8. Temporary Slope Drains
9. Temporary Seeding
12. Temporary Stream Crossings
13. Nonerodible Cofferdams
14. Prohibition of Construction Debris
15. Channel Modification
16. Sodding
17. Bank Stabilization
18. Temporary Diversion

BMPs for Soil Stabilization Measures for Low-Head Impoundment Structures and Dams

1. Check Dams
2. Diversion Structures
3. Downdrain Structures
4. Land Grading
5. Mulching and Sodding
6. Level Spreader
7. Drainage Outlet Protection
8. Riprap
9. Sediment Traps
10. Streamflow Maintenance

BMPs for Electric Line Construction and Maintenance

1. Temporary Stream Crossing

BMPs for Reservoir Releases and Tailwaters - Increasing D.O.
(BMPs for Increasing D.O. at Hydroelectric Dams)

1. Turbine Venting
2. Surface Water Pumps
3. High Purity Oxygen Injection
4. Aerating Turbine
5. Hypolimnetic Diffused Aeration or Oxygenation of the Reservoir
6. Surface Water Intake (or Selective withdrawals)
7. Watershed Management
8. Aerating Weirs
9. Reservoir Management System

BMPs for Reservoir Releases and Tailwater - Minimum Streamflow at Hydroelectric Dams

1. Reregulation Weir
2. Small Turbine
3. Pulsing Turbine
4. Sluice

EVALUATION OF BMPs

Stream Obstruction Removal

Stream obstruction removal is covered under regulatory programs of USACE and the State of Tennessee. Section 10 of the Rivers and Harbor Act (RHA) or Section 404 of the Clean Water Act (CWA) may cover this activity. State certification under subsection 401 (CWA) is required for Federal 404 permits. Aquatic Resource Alteration Permits (ARAP) are issued for activities not covered by either of these Acts. TVA has guidelines for this work in the Tennessee River Basin.

The permit issuance component of USACE and the State of Tennessee regulatory review programs could be enhanced with additional funding. Surveillance for unauthorized activities is inadequate. Funds for implementation of BMPs for federal and state projects are included as part of the project. Failure to apply BMPs by the private sector is due to a lack of funds, expertise, and understanding of benefits.

An Interagency Wetlands Committee (IWC) and a technical working group (TWG) was brought together to develop a Tennessee Wetlands Conservation Strategy by the Governor's Environmental Policy Office. The purpose of this committee is to exchange information and coordinate the programs of federal, state, and local agencies, conservation organizations and private landowners to manage conserve or restore wetlands for beneficial uses. The process began in the fall of 1989 and was first published in February 1994 and revised in January 1996. The policy is currently in its third addition published in October 1998. The goal of the State of Tennessee is to provide the maximum practicable wetlands benefits to Tennessee and her citizens by conserving, enhancing, and restoring the acreage, quality, and biological diversity of Tennessee wetlands.

Stream Channel Relocation

Stream channel relocation is covered under regulatory programs of the State of Tennessee. Section 10 (RHA) and/or Section 404 (CWA) cover this activity. State certification under subsection 401 is required for Federal 404 permits. State water quality permits are issued for other activities under the Tennessee Water Quality Control Act (TWQCA) and not covered by either of the Federal Acts.

Inspection and compliance monitoring to ensure implementation of BMPs is limited due to inadequate federal and state funding. Surveillance for non-permitted activities is inadequate. Education of contractors is needed on why BMPs are necessary and which BMPs should be used. All subcontractors should participate in an on-site pre-construction meeting on BMPs.

Additional funding would benefit the federal and state permitting process. State and federal construction projects usually include adequate funds to implement BMPs.

Regulation of stream channel relocation should remain a high priority on a statewide basis with special emphasis in urban areas and new highway corridors.

Channelization

Channelization activities are covered under regulatory programs USACE and the State of Tennessee. Section 10 (RHA) specifically prohibits the unauthorized obstruction or alteration of any navigable water of the U.S. and Section 404 (CWA) regulates the discharge of dredged and fill material into waters of the U.S. State certification under subsection 401 is required for Federal 404 permits. State water quality permits are issued for other activities under the TWQCA, which do not require an individual Federal 404 or Section 10 permit.

Inspection and compliance monitoring is limited by federal and state funding and is estimated to be about 75 percent effective and very limited in surveillance for non-

permitted activities. Contractors need education on why BMPs are necessary and which BMPs should be used. All subcontractors should participate in an on-site pre-construction meeting about BMPs.

Attention to BMPs related to channelization should remain a high priority throughout the state and especially in west Tennessee and metropolitan areas. Efforts should continue to identify and implement alternatives to channelization.

New general permits have been sent out for public review and comment, but have not had a final approval: they are Surveying and Geotechnical Exploration, Minor dredging, Alteration and restoration of intermittent streams for mining, maintenance activities, relocation of intermittent streams, Wetlands restoration and enhancement, and impoundment of intermittent streams.

Lateral Drainage and Maintenance

Lateral drainage is covered under regulatory programs of USACE and the State of Tennessee. Section 10 (RHA) or Section 404 (CWA) cover this activity. State certification under subsection 401 (CWA) is required for Federal 404 permits. State water quality permits are issued for activities not covered by either of these Acts. Federal and state agencies are doing well in implementing BMPs. Ongoing programs of county and city governments are less effective, and those of private landowners and unauthorized work are much less effective. The permit review and issuance component of USACE is adequately funded. However, compliance inspection and enforcement for unauthorized activities is inadequate.

Implementation of BMPs for state and local activities is funded by state and local governments. Failure by the private sector to apply BMPs is due to a lack of funds, expertise, or technical information.

Emphasis should be in counties that border the Tennessee River and should include counties westward to the Mississippi River.

Sand and Gravel Dredging

Section 10 (RHA) and Section 404 (CWA) apply to sand and gravel dredging in navigable waters; therefore, such activities require permit authorization under USACE's regulatory program. Also, in accordance with revisions to 330 CFR Part 323.2, effective September 25, 1993, excavation activities that destroy or degrade areas of waters of the US (i.e., cause an identifiable individual or cumulative adverse effect on any aquatic function) are considered discharges of dredged or fill material under the CWA. Accordingly, such excavation activities in all waters of the U.S. require permit authorization from USACE pursuant to Section 404 of this act. As stated previously, Section 401 certification from the State is required for work that requires an individual USACE permit under Section 404.

Sand and gravel dredging does occur in East Tennessee. While gravel excavation activities for farm, residential, or commercial purposes in smaller streams are less common in this part of the state, numerous applications are received.

Maintenance Dredging

Section 10 (RHA) governs maintenance and dredging for navigation. Certain activities, i.e. maintenance associated with recreation navigation, may be approved under a nationwide permit while other activities are subject to individual permit evaluation. If a nationwide permit is applicable, a state water quality permit may also be required. If an individual permit is required, formal section 401 certification is also required.

Bank Stabilization

Section 10 (RHA) and Section 404 (CWA) apply to bank stabilization activities. Certain relatively small projects, i.e. involving not more than 1000 linear feet of bank, where the length of the stream bank treated is less than three times the top-of-bank width of the stream channel and not more than 10 cubic yards of material placed below the normal waterline, have been previously authorized under nationwide permit, providing certain conditions are met. Longer projects require an application to the USACE. A separate state water quality permit is required for bank stabilization.

Soil Stabilization Measures for Low-Head Impoundments Structures and Dams

Construction of low-head impoundment structures and dams is covered by regulatory programs of USACE of Engineers and the State of Tennessee. The RHA applies to the construction of such structures on navigable waters, while Section 404 (CWA) applies to the discharge of fill material involved in the construction of such structures in *all* waters of the US. State certification under subsection 401 (CWA) is required for Federal 404 permits. State water quality permits are issued for activities not requiring an individual Federal 404 or Section 10 permit. Federal construction agencies such as USACE, TVA, and NRCS have erosion control guidelines which must be followed during construction.

Funding for soil stabilization measures is provided in the overall funding for a project. There is likely to be little activity in this area in the future as large federal dam construction agencies have moved from building new projects to operating and maintaining existing facilities.

Flow Modification and Regulation

Reservoir Releases and Tailwaters

Implementation of BMPs for federal dams up to this time has been on a voluntary basis. The 1987 CWA, Section 524, instructs state and federal agencies to research the water quality problems associated with dam releases, and to develop better methods of improving tailwater quality. Non-federal dams are required to implement BMPs when undergoing re-licensing by FERC. In 1996 TVA completed a five year Lake Improvement Program to develop, assess and implement BMPs. BMPs have been implemented at 12 dams for minimum flow and 10 dams for dissolved oxygen. USACE has designed one DO improvement technique at a dam in middle Tennessee and operates mainstem dams and three tributary dams to improve dissolved oxygen in reservoir releases. USACE Waterways Experiment Station is conducting research on techniques for increasing DO. Funding is a constraining factor in USACE efforts. Continued operation and maintenance of existing BMPs, and improvement in quantity and quality of reservoir releases should be a high priority for TVA and USACE.

TVA should continue to operate and maintain systems implemented under the Lake Improvement Plan and achieve minimum flows at 12 dams, and dissolved oxygen targets at 10 dams in Tennessee. TVA should continue to explore opportunities to utilize aerating turbine technology where turbine units will be replaced in the future.

BMPs for addressing water quality and aquatic habitat problems have been identified by USACE. Implementation of these BMPs needs a stronger emphasis within USACE in order to secure funding and resources. Unfortunately, USACE budget process does not have the flexibility of TVA's, where the majority of restoration efforts are funded directly from the power program. Funding for BMP implementation must be requested from congressional appropriations. A stronger emphasis from outside agencies (TDEC, TWRA, TDA-NPS) for complying with water quality criteria below USACE projects is needed to ensure that funding is secured to implement these BMPs.

There is a need for coordinated watershed management to minimize impacts from current and future urbanization. Improvement requires a comprehensive enforcement of existing erosion control ordinances and stormwater permits by local and state agencies. To be successful, this management must have support at the local city and county government level. Restoration efforts are needed to improve impacts from previous development including riparian zone restoration and stabilization of stream banks and stormwater conveyances.

COOPERATING PARTNER

Partners	Abbreviation
Austin Peay State University	APSU
Five Rivers Resource and Development Districts Council	FRRC&D
Knoxville Water Quality Forum	KWQF
Tennessee Association of Conservation Districts	TACD
Tennessee Department of Agriculture	TDA
Ag Resource Conservation Fund	ARC
Tennessee Department of Environment and Conservation	TDEC
Environmental Planning Office	EPO
Tennessee Department of Environment and Conservation	TDEC
Division of Natural Heritage	NH
Division of Water Pollution Control	WPC
West Tennessee River Basin Authority	WTRBA
Tennessee Department of Transportation	TDOT
Tennessee Technological University	TTU
Tennessee Valley Authority	TVA
Tennessee Wildlife Resources Agency	TWRA
University of Tennessee Water Resources Center	UTWRC
USDA:	USDA
Natural Resources Conservation Service	NRCS
Farm Services Agency	FSA
US Army Corps of Engineers	USACE

PARTNER DESCRIPTION & ENFORCEMENT MECHANISMS

Several agencies have programs to control NPS pollution resulting from Hydrologic Modification and Construction activities. These agencies include USACE, TVA, TDOT, and TDEC. The following discussion describes the responsibilities and programs of each of these agencies.

Tennessee Association of Conservation Districts (TACD)
TACD represents the 95 conservation districts across the state. The TDA NPS Program and ARC fund has had many contracts with them for BMP implementation and nps education.

The United States Army Corps of Engineers (USACE)
The USACE regulates activities in navigable waters of the U.S. under the Rivers and Harbors Act of 1899 (RHA). The Act prohibits the unauthorized obstruction or alteration of any navigable water of the U.S.

Navigable waters of the US are those waters that are presently used or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce. Jurisdiction of USACE over navigable waters of the US extends laterally to the elevation of ordinary high water on non-tidal streams and lakes.

All work performed on, over, or under navigable waters requires review and permit authorization under the Act, with the exception of bridges and causeways that must be approved by the U.S. Coast Guard. Examples of work requiring approval include mooring cells and dolphins, commercial barge docks, breakwaters, recreational docks and piers, launching ramps, aerial power line crossings, submarine pipeline crossings, dredging, fills, riprap, retaining walls, intakes, and outfalls.

Section 404 of the Clean Water Act (CWA) regulates any discharge of dredged or fill material into *all* waters of the US, including wetlands. The act authorizes the USACE to issue permits for discharges of fill material in waters after appropriate public review, which may include issuance of public notices. The Environmental Protection Agency (EPA) has oversight of the Section 404 Program and can restrict discharges into certain areas after compliance with established procedures.

Section 404 permit conditions, negotiated in cooperation with other federal and state agencies, may provide control of nps pollution. The Tennessee Division of Water Pollution Control (WPC) has the authority to issue or deny Section 401 Certification of 404 permits, and may refuse to certify a project because it would violate provisions of the Tennessee Water Quality Control Act of 1977 (TWQCA).

USACE permits are normally issued for a period of three years. USACE uses various means to determine when permitted activities are commenced and completed. When a project has been completed, a follow-up compliance inspection may be conducted to ensure that the work has been constructed, and is being maintained, according to approved plans and permit conditions. Priority is given to the inspection of major projects that have more potential for adverse aquatic impacts.

Nashville District (USACE)
The Nashville District has performed several bank stabilization projects under the Continuing Authorities Program. Section 14 of the Flood control Act of 1948 allows the USACE to assist local improvements by planning designing and constructing stream back protection to halt erosion where it is threatening publicly owned facilities that can not be reasonably relocated.

USACE, under the authority of its regulatory program, does not provide financial assistance to the applicant.

The Nashville District operates a system of ten water resource projects on the Cumberland River in Tennessee and Kentucky. Implementing BMPs in these reservoirs requires coordination and funding from various USACE operational groups that may be affected by the BMPs. Beginning in 1970, USACE began monitoring and documenting water quality conditions within the Cumberland River Basin. Research on methods to improve conditions has been performed both within USACE (including the Waterways Experiment Station) and by agencies with similar problems, such as TVA and the Bureau of Reclamation

The Cumberland River reservoirs can be broadly grouped into two categories based on morphological and hydrologic characteristics: (1) mainstem Cumberland River reservoirs and (2) tributary storage reservoirs. The operation of USACE reservoirs for originally-authorized purposes, such as hydropower and flood control, has both localized and cumulative effects. Cumulative effects are the relationships between the operation of upstream tributary reservoirs and water quality conditions in downstream mainstem reservoirs.

Recent evaluations identify BMPs for addressing water quality problems that cannot be addressed by operational changes alone. A brief description of efforts currently in operation at USACE reservoirs in 1) mainstem Cumberland River reservoirs, 2) Cumberland River tributary storage reservoirs, and 3) related watershed evaluations is summarized below.

Mainstem Cumberland River Reservoirs
The mainstem reservoirs are Cordell Hull, Old Hickory, Cheatham, and Barkley (KY-TN). The operation of the Cumberland River system has been evaluated to determine flow requirements to maintain dissolved oxygen (DO) levels in mainstem reservoir releases. Water quality conditions in mainstem reservoirs are largely controlled by travel times through the lakes, which is related to DO depletion. Old Hickory Dam is generally the control point for DO levels for mainstem river projects. Seasonal flow criteria has been implemented to prevent violations of DO criteria (5 mg/l) below Old Hickory Dam. Real-time information and modeling are periodically evaluated to ensure current conditions are satisfactory. Consequently, violations at the other mainstem projects are avoided. The tributary storage reservoirs are Center Hill, Dale Hollow and J. Percy Priest.

Center Hill and Dale Hollow Dams

During 1997, particularly severe dissolved oxygen (DO) problems were observed at both Center Hill and Dale Hollow lakes. These conditions were the result of late spring rains that caused a significant volume of cold, oxygenated water that had been stored over the winter to be evacuated. This high quality water was replaced with warmer, nutrient laden water from the runoff which ultimately exacerbated the DO depletion in the two lakes.

In 1997 DO levels in the releases from Center Hill Dam fell below 6 mg/l by mid summer and reached a minimum of about 1 mg/l in early October. In an effort to improve DO conditions in the tailwater reach hydropower generation was limited to 78% of capacity during this period of stressed DO conditions. This special operation, which results in more air being entrained in the power releases, continued until early December.

At Dale Hollow, DO levels in the hydropower releases declined throughout the summer reaching a minimum of 2 mg/l in late September. Power generation was limited to 61% of capacity during this period, which improved release quality by 0.5 to 1.7 mg/l depending upon flow conditions and reservoir water quality. This special operation was maintained until mid-November.

The USACE carried out extensive studies designed to quantify the extent and severity of low DO in the Center Hill and Dale Hollow tailwaters. These surveys, conducted during the fall of 1997, indicated the low DO problems affect more extensive reaches, more profoundly, than previously assumed.

During 1998, some progress was made by the USACE in implementing measures to improve outflow DO from Center Hill and Dale Hollow dams. One turbine was outfitted at Center Hill with hub baffles, and studies were initiated at Dale Hollow to investigate measures to improve outflow DO.

1998 was also a severe year for DO depletion at both Center Hill and Dale Hollow. At Center Hill, DO in the releases dropped to about 4 mg/l by late July. Power generation was limited to about 80% of capacity. This caused an increase of approximately 0.5 mg/l in average daily outflow DO. The operating restrictions were lifted in early December 1998 after the lake destratified.

At Dale Hollow DO levels also fell to about 4 mg/l by late July. Power generation was limited to 60% of capacity. This improved the average daily outflow DO by about 1.0 mg/l. The operating restrictions were lifted in early December 1998.

The year 1999 was not as severe a year for DO depletion as 1997 or 1998. At Center Hill, a restricted capacity operation was used between September and late November. Priority was given to operating with the unit equipped with hub baffles. At Dale Hollow, power generation was restricted to 60% of capacity in early September. One unit at Dale Hollow had recently been outfitted with hub baffles and priority was given to operating with this unit. The reduced capacity operation at Dale Hollow ended in late November 1999.

Concerning the minimum flow issue below Center Hill, a proposed weir about two miles downstream from the dam was canceled for engineering and environmental reasons. However, the USACE is investigating other options to provide a continuous minimum flow in the tailwater. Studies continue and no final recommendations have been made as yet.

J. Percy Priest

At J. Percy Priest in recent years studies have been conducted into methods for improving the seasonal DO depletion in hypolimnetic waters in the dam's forebay. The most promising remedy is some kind of oxygen injection system. At this point both line diffuser and inverted oxygen cone systems are being actively evaluated. A funding mechanism for operating an oxygen system has not been secured either.

Note that during 1998 the single turbine at J. Percy Priest Dam was taken out of service part of the year. As a result, from July through December, releases were made through the spillway. This maintained DO levels in excess of 7 mg/l. With the return of the unit to service, the spillway releases were suspended.

Watershed Evaluations

The USACE is actively involved in evaluating watershed problems, particularly in the Nashville area. Many instances of construction activities with inadequate BMPs have been observed. There is a general lack of awareness of water quality impacts from urbanization in streams and downstream lakes. Requirements of the NPDES stormwater permits for construction sites greater than five acres have been largely ignored. This aggravates problems with reservoir releases by exacerbating DO depletion within the reservoirs. This problem is more significant in the watersheds surrounding J. Percy Priest, Old Hickory, and Center Hill Lakes.

In addition to active construction activities, existing development can induce changes in hydrologic regime and sediment load with resulting channel instability. These types of problems are evident in many locations around Nashville.

Tennessee Valley Authority

TVA is a federal agency that operates and manages the dams and reservoirs on the Tennessee River system for multipurpose development. The following programs cover activities associated with hydrologic modification and construction activities:

Section 26a Review and Approvals--Section 26a of the TVA Act requires that TVA's approval be obtained prior to the construction, operation, or maintenance of any dam, appurtenant works, or other obstruction affecting navigation, flood control, or public lands and reservations across, along, or in the Tennessee River or any of its tributaries. Such obstructions include, but are not limited to, boat docks, piers, boat houses, rafts, buoys, floats, boat-launching ramps, bridges, aerial utility crossings, and fills.

If the construction, maintenance, or operation of a proposed facility or structure, or any part thereof for which approval is sought may result in any discharge into navigable waters of the US, the applicant must also submit a certification in accordance with Section 401 CWA. This certification documents, with reasonable assurance, that the proposed activity will not violate applicable water quality standards.

It is required that all land-disturbing activities be conducted in accordance with Section 208 CWA, and that BMPs to control erosion and sedimentation be implemented to prevent adverse water quality and related aquatic impacts. The applicant must provide an erosion and sediment control plan for projects, activities, or actions that, in TVA's judgment, have the potential for a substantial adverse impact.

A number of federal (USACE, EPA, U.S. Coast Guard, etc.) and state programs regulate some of the activities that are covered under Section 26a. However, no program, other than statutory authority, expressly mandates the consideration of the three areas specified in Section 26a of the TVA Act (navigation, flood control, and public lands or reservations) in terms of the unified development and regulation of the Tennessee River and its tributaries. TVA cooperates closely with other agencies having similar regulatory responsibilities. Such cooperation between USACE and TVA has substantially improved understandings between the agencies, increased the opportunity for public input to the review and approval process, and reduced the paperwork burden placed on Section 26a applicants.

Lake Improvement Plan

TVA has completed a five-year Lake Improvement Plan. The plan was to improve the quality of the tailwater releases by improving DO levels in releases from TVA dams and enhancing and/or stabilizing flows below TVA dams.

Flow releases from TVA dams were generally low in DO during much of the traditional recreation season that extends from May through October. In addition, these releases were intermittent resulting in dry streams below the tributary dams for extended periods of time. Consequently, the tailwaters below the tributary dams had not retained their inherent potential to generate recreation and fishing benefits and to provide economic support to communities located along the streams. To explore ways to enhance water quality (primarily DO) and water supply, TVA undertook an extensive study and testing program in 1980.

A brief description of accomplishments at specific TVA dams in Tennessee since implementation of the Lake Improvement Plan is described below.

Minimum Flow Systems

Minimum flow systems have been implemented at 12 dams using three technologies. These water quality improvements will help in the recovery of aquatic habitat lost to intermittent drying of the river bed.

- Re-regulation weirs - (2) South Holston and Norris
- Small hydropower units - (1) Tims Ford
- Turbine pulsing operations - (9) Wilbur, Cherokee, Fort Patrick Henry, Douglas, Appalachia (dam located at Tennessee-North Carolina state line), USACE No. 1, Boone, Chickamauga, and Pickwick.

Aeration Systems

Aeration systems have been implemented at 10 dams to meet TVA dissolved oxygen targets. Multiple systems are required at some projects to attain desired results.

- Oxygen injection - (5) Cherokee, Douglas, Fort Loudoun, Tims Ford, and Watts Bar
- Surface water pumps - (2) Cherokee and Douglas
- Aeration weirs - (1) South Holston
- Air compressors - (1) Tims Ford
- Turbine venting systems - (4) Boone, South Holston, Appalachia, and Watauga
- Aerating Turbine - (1) Norris

These systems performed well and reduced the number of days DO concentrations were below target by more than 80%. Stream bioassessments in the TVA tailwaters confirm that increased streamflows and dissolved oxygen concentrations have improved fish and aquatic life.

Tennessee Department of Environment and Conservation (TDEC)

State water pollution control regulatory programs are authorized by the Tennessee Water Quality Control Act of 1977, (T.C.A. 69-3-101, et seq.). Tennessee Division of Water Pollution Control (WPC) has the responsibility of requiring permits for projects that physically alter waters of the state, such as gravel dredging, some water withdrawals, impoundments, and channel-alteration activities. A summary of specific programs within WPC that address activities related to NPS pollution follows.

State Water Quality Permit

Since the 1971 Water Quality Control Act was passed, WPC issues water quality permits for a variety of activities that may impact the waters of the state, but do not have a point source discharge and are not covered by the NPDES program. Examples of these activities include sand and gravel dredging not requiring an individual Federal 404 (CWA) or Section 10 (RHA) permit, bridge construction, clearing and snagging in streams for debris removal, and stream channel alterations.

In 1985 the establishment of the ARAP program improved consistency and uniformity of water quality permitting. Twelve General Permits have been established to address the following activities: launching ramp construction; alteration of wet weather conveyances; minor road crossings; utility line

crossings; stream bank stabilization; sand and gravel dredging; debris removal; emergency road repair; stream restoration and enhancement; minor wetlands alterations; bridge scour repair; and application of herbicides in aquatic systems. General permits specify circumstances under which each applies, and establish conditions equivalent to BMPs that must be followed for an activity to be authorized by the general permit. Other alterations may be authorized by individual ARAPs. The intent of all permits is to maintain the ability of the state's waters to support classified uses.

The intent of all permits is to maintain the ability of the state's waters to support classified uses. ARAP Handbook: http://www.state.tn.us/environment/permits/handbook/arap.htm.

Certification of Federal Permits

In addition to state permits, WPC processes Section 401 water quality certifications, as required by the CWA. Certifications are for federal permits issued by USACE, the US Coast Guard, FERC, and TVA. Most federal permit reviews are of USACE Section 404 permits for discharge of dredged or fill materials associated with stream relocations and channelization, work in wetlands, bridge construction and commercial and recreational dock facilities. Through the conditions of these permits, WPC regulates nps pollution from activities involving the deposition of fill material in waters of the state, including wetlands.

TDEC Strategic Plan

In January 1999, TDEC initiated a 4-year Strategic Plan. Goal 1 of the strategy states that the department will protect, preserve and improve the quality of Tennessee's air, land and water.
Objective 1-C Protect and enhance Tennessee's rivers, lakes, wetlands and ground water to ensure a healthy environment.
1-C-1: Complete the assessment and prioritization of 32 watersheds under the Department's water quality management plan by January 1, 2003
1-C-3: By January 1, 2003, develop control strategies on 100 streams that are listed on the 303(d) list of stream that are not achieving compliance with at least one use classification in conjunction with state and federal partners.
1-C-6: Achieve no net loss of wetlands over the next four years.
1-C-7: Restore 70,000 acres of wetlands by June 30, 2000 (compared to 1994).
1-C-9: Monitor water quality of rivers, lakes, wetlands, and ground water and report annually on improvements in water quality conditions throughout the state.

Tennessee Department of Environment and Conservation: West Tennessee River Basin Authority (WTRBA)

The WTRBA, formerly the Obion-Forked Deer Basin Authority, was formed in 1996. The WTRB expanded scope now includes other waters, notably the Hatchie River. The WTRB primary purpose is to preserve the natural flow and function of the Hatchie, Obion and Forked Deer River Basins through environmentally sensitive stream maintenance, and appropriate conservation practices in upland settings. The geographic area of responsibility includes all or part of seventeen counties in West Tennessee.

The WTRB is charged with maintaining and stabilizing the function of channelized streams and rivers where the land use is well established and for which restoration of natural stream or river function is not practicable. Likewise the WTRB will, where practicable, restore natural stream and floodplain dynamics and associated economic benefits such as fisheries and wildlife habitat, wetlands, water quality, and naturally or economically productive bottomland hardwood forests.

Tennessee Department of Transportation (TDOT)

TDOT is governed by both federal and state rules and regulations in the planning, design, and construction of highways, bridges and culverts. The department, operates under the guidelines in Standard Specifications for Road and Bridge Construction, and implements provisions contained in A Policy on Geometric Design of Highways and Streets, Best Management Practices for Erosion and Sediment Control, the Tennessee Water Quality Control Act, Section 404 (CWA), and other federal regulations. TDOT is presently using BMPs to control nps pollution from highway and bridge construction as described in Reducing Nonpoint Source Water Pollution by Preventing Soil Erosion and Controlling Sediment on Construction Sites: A Training Manual for Construction Inspection Personnel. The department also conducts regional workshops annually to discuss construction practices and problems encountered in highway and bridge construction.

The guidelines to be followed by the project engineer and the contractor in the construction of highways and bridges are outlined in Standard Specifications for Road and Bridge Construction. "Section 209 - Project Erosion and Siltation Control" in the manual details specific measures to be used to control sediment on highway projects.

In the development of project plans, the design engineer, uses as a guide A Policy on Geometric Design of Highways and Streets developed by the American Association of State Highway and Transportation Officials. The designer also uses Design Guidelines and Instructional Bulletins, Standard Roadway Structures Drawings, and Erosion and Sediment Control Guidelines developed by TDOT. These manuals and guidelines describe in detail appropriate methods of erosion control during construction.

The designer uses these guidelines and field information to plot the drainage patterns associated with the project and to develop the erosion control plan that is incorporated into the construction plans. Appropriate notes are included on the plan sheets as guidance for the contractor in implementing the plan. It is the responsibility of the assigned project engineer to ensure that the erosion control plan is implemented. Any improvements or adjustments to the erosion control plan are made at the discretion of the project engineer.

All grade and drain projects crossing “blue line” streams or impacting jurisdictional wetlands require a Section 404 (CWA) Permit. Any construction project that impacts waters of the state requires a state water quality permit (ARAP or 401 Certification) under the TWQCA. Any construction project that disturbs more than 5 acres of land requires a NPDES permit. These permits require the implementation of BMPs to control erosion and minimize pollution.

TDOT has a Technology Transfer and Research Program through which the department tests new materials, develops training courses and manuals, and conducts research that will benefit the TDOT in constructing a safe, efficient, and environmentally-sensitive transportation system.

In 1992, TDOT conducted several workshops on the proper installation and maintenance of soil erosion and sediment controls. The workshops were conducted at each regional office and attended by over 600 construction personnel, including TDOT project inspectors. In 1993 and 1994 TDOT developed additional training courses for design and construction personnel in the sizing and designing of erosion controls for construction projects. The workshops were attended by over 800 TDOT personnel, contractors and consultants.

A new Environmental Coordinator position has been established in each of TDOT's regional offices across the state. The Environmental Coordinator is responsible for reviewing erosion control plans and making on-site inspections to ensure that erosion controls are implemented and properly installed.

OTHER FUNDING SOURCES

Additional funding sources for environmental projects are listed in the Catalog of Federal Funding, which can be found at: www.aspe.os.dhhs.gov/cfda

CURRENT 319 PROJECTS

Tennessee Department of Environment and Conservation-Division of Natural Heritage and TDA-Nonpoint Source Program
418 acres of wetlands in the Ghost River Section of the Wolf River were purchased in coordination with the Wolf River Conservation Initiative: $2,500 of 319(h) and $284,755 Match monies were provided by TDEC-DNH. TWRA and TNC were also partners in development of this project.

Five Rivers Resource Conservation &Development Council: Yellow Creek Project
Six streambank bioengineering restoration projects were established in the Yellow Creek watershed, Dickson County. A Landowner's Guide to Streambank Protection and Stabilization brochure and a video were also developed in partnership with TDEC, TWRA, NRCS.
http://www.state.tn.us/environment/epo/strmbank.htm.

Rhea County Soil Conservation District: Piney Creek Streambank Project
A streambank bioengineering restoration demonstration project was constructed on the bank of Piney Creek at Veteran's Park, Spring City, TN. A demonstration day was held March 23, 2000 partnering with NRCS, City of Spring City, TN, and Rhea County.

Great Smokey Mountain National Park: Streambank Restoration Demonstration Project

A streambank restoration project was established on Abram's Creek in Cades Cove section of the Park. Several types of restoration material were demonstrated. A two-day hands-on workshop was held along with a workshop with the participants doing a majority of the work.

University of Tennessee, Water Resources Center along with Knoxville Water Quality Forum: Second Creek Project.

Four streambank restoration projects were established with this project.
A two day training workshop was held on March 25-26, 1998 as part of site 1 restoration. Over 45 people attended and received hands-on training in soil bioengineering and restoration techniques on day two. A manual was also developed. The four sites were:
1. Inskip ball field: a 300 ft. section of streambank was stabilized and revegetated using soil bioengineering.
2. Goose Creek @ Mary Vestal Park: approximately 600 ft. of streambank were stabilized and revegetated using a variety of soil bioengineering techniques and native plants.
3. First Creek along the greenway in North Knoxville. The streambank stabilization work was completed in May 1998.
4. Love Creek Restoration at Holston Middle School site, February – May 1999.

Austin Peay State University, Center for Field Biology:
West Sandy Project:

A series of low head log dams were installed along with in-stream log weirs and beaver dam levelers were demonstrated. A Riparian Streambank Restoration Conference was held in association with this project also.

Sulphur Fork Creek Project:

Plans are to apply bioengineering to stabilize streambanks as well as eroding ditches in this project.

Friends of the North Chickamauga Creek Conservancy

A stream bank restoration project was done in the lower half of the North Chickamauga Creek watershed. The project involved assistance from at least seven local, state, and federal agencies including some sixty resource experts and numerous citizen. Since the construction, one landowner workshop and at least 6 field days have been held at the site.

Tennessee Technology University along with Hull York Lakeland RC&D Council, city of Cookeville and NRCS

A lake bank restoration project was established at Cane Creek Park Lake in Cookeville, TN. It involved installation of wave action retardant devices as well as low-lying vegetation to stabilize a section of the lake bank along a walking trail. 110 feet of coconut biolog fiber roll with live stakes were installed along with 110 feet of live stakes and riprap. In addition, signs have been designed to be installed along a walking trail, at the lake, discussing the restoration techniques and nps pollution. Several tours will be held at the site to demonstrate the restoration techniques.

Heavy use area protection and stream crossing project: DeKalb Soil Conservation District
A combined heavy use and stream crossing was installed in DeKalb County. Along with it, an information brochure was developed and a field day was held at the site.

Hamblin and Hawkins Soil Conservation District FY-95 Bent Creek
With technical assistance of NRCS, 3,000 feet of stream bank restoration and two acres of tree plantings have been funded as part of the FY-95 NPS Bent Creek Project.

Master Degree Study entitled "Water Quality and Ecological Impacts of Watering Cattle Adjacent to a Small Middle Tennessee Stream" by Jeff Powell, December 1998.
In this study, three practices were compared: at site 1) cattle with "no access" to the stream were given an alternative water source; at site 2) cattle had access to an "improved" area stream crossing; and at site 3) cattle had "free access" to the stream. Results show statistically significant differences (α=0.05) in nitrate, ammonia, and fecal coliform bacterial levels where cattle had free access to the stream. In areas where cattle were completely restricted, or had limited access to the stream, significant differences were only detected for nitrate, when compared to the Control. Research indicated that statistically significant differences in water quality could be achieved by restricting and/or limiting cattle access to streams.

Unified Watershed Assessment Projects
In the FY-2000 UWA projects, there is potential for streambank restoration projects in four watersheds: Hatchie watershed: Cypress Creek; Hiwassee watershed: Oostanaula above Athens; French Broad watershed: Dunn Creek and East Fork Creek and Watauga watershed: Roan Creek.

319 Projects involving Hydrologic Modification

Grant Yr.	Project Title	Location
FY-94	West Sandy Watershed Project	West Sandy Creek
FY-95	Bent Creek	Bent Creek Watershed
FY-96	UT Urban Manual/workshop (phase I)	statewide
FY-98	UT Urban Manual/workshop (phase II)	statewide
FY-98	Grant Pool	303(d) streams
FY-99	Grant Pool	303(d) streams
FY-99	Five Rivers: Urban NPS Demo & Education	Red River: Sulphur Fork Creek: Harpeth River, Duck, Buffalo River, Yellow Creek, Hurricane Creek and Jones Creek
FY-99	Smokey Mountains: TN Valley Urban NPS	Nolichucky River, French Broad River, Holston River, Little Tennessee

		River, Little River
FY-2000	OHV: Off-Road Vehicles Committee	Statewide

Tennessee Wetlands Acquisition, Restoration and Management by partners:

Wetlands Acquired by TWRA Wetlands Acquisition Funding 1986 through 8-31-99: 44,681 acres
Wetlands Enrolled in USDA in Tennessee in the Wetlands Reserve Program 1994-98 (restored wetlands under permanent and 30 year conservation easements): Permanent restored wetlands 5,047 acres permanent restorable wetlands 1,540 acres 30 year conservation easements restored 30 acres 30 year conservation easements restorable 751 acres *(est. FY-99 30yr restorable = 210ac; permanent restorable = 1,162 acres)*

AREAS FOR PROGRAM EXPANSION

- Increase education efforts focused towards the river functions and their association with surface water quality.
- Develop statewide public awareness campaigns reaching property owners, construction companies, developers, city, and county officials.
- Work with county governments to initiate programs addressing environmentally sensitive land use and development.
- Target 303(d) streams with Grant Pool money that have construction as source of pollution.

MEASURES OF SUCCESS

- All streams that are on the 303(d) list because of hydrologic modification have been taken off the list and none are being added.
- Increase the number of people that realize the importance of stable functioning streams and wetlands and their association with land use and water quality.
- Continual increase of wetlands protected, restored and/or put into a reserve program.
- Increase the number of developments, i.e. private, state and commercial that take into consideration the hydrology of the area and builds to retain pre-development hydrology.

MILESTONES

Long Term Goal 1.

Hold regularly scheduled meetings with stakeholders, to create new partnerships, to strengthen existing partnerships and to foster greater trust, commitment and accountability.

- **Action 1**: The Construction-Hydrologic Modification Working Group (CHWG) will meet semi-annually.
  Lead: TDA-NPS Program
  Key partners: TDEC-EPO-WPC-WTRBA, TVA, TDOT, USACE, USDA, TNRC&D, FHA, UTWRRC, TTU, APSU, KWQF, TWRA, Consultant firms
  Year(s): 2001 – 2005

- **Action 2**: Increase CHWG membership by one member each year.
  Lead: TDA-NPS Program
  Key partners: TDEC-EPO-WPC-WTRBA, TVA, TDOT, USACE, USDA, TNRC&D, FHA, UTWRRC, TTU, APSU, KWQF, TWRA, Consultant firms
  Year(s): 2001 – 2005

- **Action 3**: Establish a CHWG mission statement, a list of collective capabilities, and priorities for funding.
  Lead: CHWG
  Key partners: TDA-NPS Program, TDEC-EPO-WPC-WTRBA, TVA, TDOT, USACE, USDA, TNRC&D, FHA, UTWRRC, TTU, APSU, KWQF, TWRA, Consultant firms
  Year(s): 2001-2005

- **Action 4**: Work with other agencies to develop Hydrologic Modification projects.
  Lead: CHWG
  Key partners: TDA-NPS Program, TDEC-EPO-WPC-WTRBA, TVA, TDOT, USACE, USDA, TNRC&D, FHA, UTWRRC, TTU, APSU, KWQF, TWRA, Consultant firms
  Year(s): 2001-2005

- **Action 5**: Develop Memoranda of Agreement with key federal agencies to improve programmatic consistency.
  Lead: TDA-NPS Program
  Key Partners: All federal agency partners
  Year(s): 2001-2005

Long Term Goal 2.

Fully implement all developed TMDLs for nonpoint sources in compliance with existing regulations, policies, or agreements by 2015.

Refer to Chapter 1.11, TMDL Implementation for specific action items related to this Long Term Goal.

Long Term Goal 3.

Restore all waters impaired by nonpoint sources that are listed on the 1998 303(d) List to the condition of fully supporting their designated uses by 2015, in cooperation with local, state and federal partners.

- **Action 1**: 20% of the streams impaired due to hydrologic modification on the 1998 303(d) List will support their designated uses.
  Lead Agencies: TDA-NPS Program
  Key partners: TDA-NPS Program, TDEC-WPC, TVA, USACE, USDA, TNRC&D, UTWRRC, TTU, APSU, KWQF, Consultant firms
  Year(s): 2005

- **Action 2**: 40% of the streams impaired due to hydrologic modification on the 1998 303(d) List will support their designated uses.
  Lead: TDA-NPS Program
  Key partners: TDA-NPS Program, TDEC-WPCTVA, USACE, USDA, TNRC&D, UTWRRC, TTU, APSU, KWQF, Consultant firms
  Year(s): 2010

- **Action 3**: 60% of the streams impaired due to hydrologic modification on the 1998 303(d) List will support their designated uses.
  Lead Agencies: TDA-NPS Program
  Key partners: TDA-NPS Program, TDEC-WPC, TVA, USACE, USDA, TNRC&D, UTWRRC, TTU, APSU, KWQF, Consultant firms
  Year(s): 2015

- **Action 4**: Develop at least two projects that addresses hydrologic modification 303(d) streams for 319 funded projects.
  Lead: TDA-NPS Program
  Key partners: TDA-NPS Program, TDEC-EPO-WPC-WTRBA, TVA, TDOT, USACE, USDA, TNRC&D, FHA, UTWRRC, TTU, APSU, KWQF, TWRA, Consultant firms
  Year(s): 2001-2005

- **Action 5**: Continue operation and maintenance of dissolved oxygen and aeration systems, minimum flows at dams installed under TVA's Lake Improvement Plan in the Tennessee River Watershed.
  Lead: TVA
  Key partners: TDA-NPS Program, TDEC-EPO-WPC-WTRBA, TVA, TDOT, USACE, USDA, TNRC&D, FHA, UTWRRC, TTU, APSU, KWQF, TWRA, Consultant firms
  Year(s): 2001-2015

- **Action 6**: Develop comprehensive tailwater and water quantity released management strategy for USACE reservoirs.
  Lead: USACE

Key partners: TDA-NPS Program, TDEC-EPO-WPC-WTRBA, TVA, TDOT, USACE, USDA, TNRC&D, FHA, UTWRRC, TTU, APSU, KWQF, TWRA, Consultant firms
Year(s): 2001-2005

- **Action 7**: Install hub baffles, dissolved oxygen, and supplemental air systems on The Cumberland River: one unit at each dam.
  Lead: USACE
  Key partners: TDA-NPS Program, TDEC-EPO-WPC-WTRBA, TVA, TDOT, USACE, USDA, TNRC&D, FHA, UTWRRC, TTU, APSU, KWQF, TWRA, Consultant firms
  Year(s): 2001-2005

- **Action 8**: As part of hydropower upgrade, investigate autoventing turbines.
  Lead: USACE
  Key partners: TDA-NPS Program, TDEC-EPO-WPC-WTRBA, TVA, TDOT, USACE, USDA, TNRC&D, FHA, UTWRRC, TTU, APSU, KWQF, TWRA, Consultant firms
  Year(s): 2001-2005

- **Action 9**: On J. Percy Priest Dam, evaluate hypolimnetic oxygen systems to address the build-up of anoxic products in the forebay and to improve release water quality.
  Lead: USACE
  Key partners: TDA-NPS Program, TDEC-EPO-WPC-WTRBA, TVA, TDOT, USACE, USDA, TNRC&D, FHA, UTWRRC, TTU, APSU, KWQF, TWRA, Consultant firms
  Year(s): 2001-2005

- **Action 10**: Provide continuous flow of 200 cfs at Center Hill Dam Design and construct re-regulation weir.
  Lead: USACE
  Key partners: TDA-NPS Program, TDEC-EPO-WPC-WTRBA, TVA, TDOT, USACE, USDA, TNRC&D, FHA, UTWRRC, TTU, APSU, KWQF, TWRA, Consultant firms
  Year(s): 2001-2005

- **Action 11**: Implement and evaluate turbine venting on at least one unit, and preferably, on all unit projects on Center Hill and Dale Hollow Dams.
  Lead: USACE
  Key partners: TDA-NPS Program, TDEC-EPO-WPC-WTRBA, TVA, TDOT, USACE, USDA, TNRC&D, FHA, UTWRRC, TTU, APSU, KWQF, TWRA, Consultant firms
  Year(s): 2001-2005

Long Term Goal 4.

Beginning in 2006, through regulatory and non-regulatory means, prevent previously unlisted waters from being included on the 303(d) List because of nonpoint source impairments.

- **Action 1**: Meet with organizaitons in an effort to increase level of evaluation, speed permit processing, and strengthen surveillance, compliance, and enforcement regulatory programs.
  Leads: TDEC-WPC, TDA-NPS Program
  Key partners: TDA-NPS Program, TDEC-EPO-WPC-WTRBA, TVA, TDOT, USACE, USDA, TNRC&D, FHA, UTWRRC, TTU, APSU, KWQF, TWRA, Consultant firms
  Year(s): 2001-2005

- **Action 2**: Develop two land easement projects and encourage other 319 projects to develop land easements.
  Lead: TDA-NPS Program
  Key partners: TDA-NPS Program, TVA, USACE, USDA, TNRC&D, FHA, UTWRRC, TTU, APSU, KWQF, TWRA, Consultant firms
  Year(s): 2001-2005

- **Action 3**: Hold a meeting with USDA-FSA to encourage expansion of qualification of buffer set asides.
  Lead TDA-NPS Program
  Key partners: TDA-NPS Program, USDA-FSA
  Year(s): 2005

- **Action 4**: Establish meaningful state wetlands use classifications and water quality standards.
  Lead: TDEC-WPC
  Key partners: TDA-NPS Program, TDEC-EPO-WPC, TVA, TDOT, USACE, TNRC&D, UTWRRC, Consultant firms
  Year(s): 2005-2015

Long Term Goal 5.

Improve the knowledge of stakeholders and citizens concerning the origins, magnitude, and prevention of nonpoint source pollution, and how to prevent it.

- **Action 1**: Conduct one workshop for state, local, and federal personnel involved in Stream/flood plain management or in providing of technical assistance to landowners and others on stream management, and flood mitigation issues.
  Lead: TDA-NPS Program
  Key partners: TDA-NPS Program, TDEC-WPC, TVA, TDOT, USACE, TNRC&D, UTWRRC, TWRA, Consultant firms
  Year(s): 2005-2015

- **Action 2**: Develop two Outdoor Classroom projects that incorporate wetland conservation and protection.
  Lead: TDA-NPS Program
  Key partners: TDA-NPS Program, TDEC-EPO-WPC-WTRBA, TVA, TDOT, MTSU, USACE, USDA, TNRC&D, FHA, UTWRRC, TTU, APSU, KWQF, TWRA, Consultant firms
  Year(s): 2005-2005

- **Action 3**: Continue to be a member and participate in the Interagency Wetlands Committee (IWC) and a technical working group (TWG).
  Lead: TDEC-EPO
  Key partners: TDA-NPS Program, TDEC-WPC-WTRBA, TVA, TDOT, USACE, USDA, TNRC&D, UTWRRC, TTU, APSU, TWRA, Consultant firms
  Year(s): 2005-2015

- **Action 4**: Conduct one workshop, with associated literature, bank stabilization, bio-engineering, fluvial geomorphology and riparian zone restoration targeting state, local, and federal personnel or individuals involved in providing technical assistance to landowners.
  Lead: TDA-NPS Program
  Key partners: TDA-NPS Program, TDEC-WPC, TVA, TDOT, USACE, TNRC&D, UTWRRC, TWRA, Consultant firms
  Year(s): 2005-2015

- **Action 5**: Develop a focused awareness campaign on water supply and water withdrawal issues reaching property owners, construction companies, developers, city, and county officials.
  Lead: TDA-NPS Program
  Key partners: TDA-NPS Program, TDEC-EPO-WPC, TVA, TDOT, USACE, TNRC&D, UTWRRC, Consultant firms
  Year(s): 2005-2010

- **Action 6**: Meet with involved organizations to investigate the possibility of TDA-NPS Program using (TDEC – TDOT stream culvert) mitigation money to fund stream restoration BMPs.
  Leads: TDEC-WPC, TDOT and TDA-NPS Program
  Key partners: TDA-NPS Program, TDEC-WPC, TDOT
  Year(s): 2005-2005

Long Term Goal 6.

Through the process of continuous improvement, routinely assess all programmatic functions of the TDA-NPS Program in order to maximize efficiency, decrease the bureaucratic burden and increase the numbers of participants in the program.

- **Action 1**: Investigate other funding sources as well as EPA.
  Lead: TDA-NPS Program
  Key partners: TDA-NPS Program, TDEC-EPO-WPC-WTRBA, TVA, TDOT, MTSU, USACE, USDA, TNRC&D, FHA, UTWRRC, TTU, APSU, KWQF, TWRA, Consultant firms
  Year(s): 2001-2005

- **Action 2**: Fund at least one demonstration project annually which will demonstrate methods to mitigate hydrologic modification polluted runoff.
  Lead: TDA-NPS Program
  Key Partners: TDA-NPS Program, TDEC-EPO-WPC-WTRBA, TVA, TDOT, MTSU, USACE, USDA, TNRC&D, FHA, UTWRRC, TTU, APSU, KWQF, TWRA, Consultant firms
  Year(s): 2000-2015 and beyond

Long Term Goal 7.

Use the maximum allowable percentage of funding annually to assist partners with water quality monitoring and assessment, for the duration of the 319 program.

See Chapter 1.9 for action items related to water quality monitoring for the TDA-NPS Program.